Resistant cultures showed no lysis in the area where the phage lysate has been placed after incubation at 30°C for 24 hours.

2.8 TRANSGENIC HOSTS/TRANSFORMED CELLS COMPRISING CRY1C* DNA SEGMENTS

The invention also discloses and claims host cells, both native, and genetically engineered, which express the novel *cry1C** genes to produce Cry1C* polypeptides. Preferred examples of bacterial host cells include *Bacillus thuringiensis* NRRL B-21590, NRRL B-21591, NRRL B-21592, NRRL B-21638, NRRL B-21639, NRRL B-21640, NRRL B-21609. and NRRL B-21610.

Methods of using such cells to produce Cry1C* crystal proteins are also disclosed. Such methods generally involve culturing the host cell (such as *Bacillus thuringiensis* NRRL B-21590, NRRL B-21591, NRRL B-21592, NRRL B-21638, NRRL B-21639, NRRL B-21640, NRRL B-21609. or NRRL B-21610) under conditions effective to produce a Cry1C* crystal protein, and obtaining the Cry1C* crystal protein from said cell.

In yet another aspect, the present invention provides methods for producing a transgenic plant which expresses a nucleic acid segment encoding the novel recombinant crystal proteins of the present invention. The process of producing transgenic plants is well-known in the art. In general, the method comprises transforming a suitable host cell with one or more DNA segments which contain one or more promoters operatively linked to a coding region that encodes one or more of the novel *B. thuringiensis* Cry1C-R148A, Cry1C-R148G, Cry1C-R148M, Cry1C-R148L, Cry1C-R180A, Cry1C-R148D, Cry1C.499, Cry1C563 and Cry1C.579 crystal proteins. Such a coding region is generally operatively linked to a transcription-terminating region, whereby the promoter is capable of driving the transcription of the coding region in the cell, and hence providing the cell the ability to produce the recombinant protein *in vivo*. Alternatively, in instances where it is desirable to control, regulate, or decrease the amount of a particular recombinant crystal protein expressed in a particular transgenic cell, the invention also provides for the expression of crystal protein antisense mRNA. The use of antisense mRNA as a means

of controlling or decreasing the amount of a given protein of interest in a cell is well-known in the art.

Another aspect of the invention comprises a transgenic plant which express a gene or gene segment encoding one or more of the novel polypeptide compositions disclosed herein. As used herein, the term "transgenic plant" is intended to refer to a plant that has incorporated DNA sequences, including but not limited to genes which are perhaps not normally present, DNA sequences not normally transcribed into RNA or translated into a protein ("expressed"), or any other genes or DNA sequences which one desires to introduce into the non-transformed plant, such as genes which may normally be present in the non-transformed plant but which one desires to either genetically engineer or to have altered expression.

It is contemplated that in some instances the genome of a transgenic plant of the present invention will have been augmented through the stable introduction of one or more Cry1C-R148A-, Cry1C-R148D-, Cry1C-R148G, Cry1C-R148M, Cry1C-R148L, Cry1C-R180A- Cry1C.499-, Cry1C.563-, or Cry1C.579-encoding transgenes, either native, synthetically modified, or mutated. In some instances, more than one transgene will be incorporated into the genome of the transformed host plant cell. Such is the case when more than one crystal protein-encoding DNA segment is incorporated into the genome of such a plant. In certain situations, it may be desirable to have one, two, three, four, or even more *B. thuringiensis* crystal proteins (either native or recombinantly-engineered) incorporated and stably expressed in the transformed transgenic plant.

A preferred gene which may be introduced includes, for example, a crystal protein-encoding a DNA sequence from bacterial origin, and particularly one or more of those described herein which are obtained from *Bacillus* spp. Highly preferred nucleic acid sequences are those obtained from *B. thuringiensis*, or any of those sequences which have been genetically engineered to decrease or increase the insecticidal activity of the crystal protein in such a transformed host cell.

Means for transforming a plant cell and the preparation of a transgenic cell line are well-known in the art, and are discussed herein. Vectors, plasmids, cosmids, YACs (yeast artificial chromosomes) and DNA segments for use in transforming such cells will,

of course, generally comprise either the operons, genes, or gene-derived sequences of the present invention, either native, or synthetically-derived, and particularly those encoding the disclosed crystal proteins. These DNA constructs can further include structures such as promoters, enhancers, polylinkers, or even gene sequences which have positively- or negatively-regulating activity upon the particular genes of interest as desired. The DNA segment or gene may encode either a native or modified crystal protein, which will be expressed in the resultant recombinant cells, and/or which will impart an improved phenotype to the regenerated plant.

Such transgenic plants may be desirable for increasing the insecticidal resistance of a monocotyledonous or dicotyledonous plant, by incorporating into such a plant, a transgenic DNA segment encoding a Cry1C-R148A, Cry1C-R148D, Cry1C-R148G, Cry1C-R148L, Cry1C-R148M, Cry1C-R180A, Cry1C.499, Cry1C.563, and/or Cry1C.579 crystal protein which is toxic to lepidopteran insects. Particularly preferred plants include grains such as corn, wheat, barley, maize, and oats; legumes such as soybeans; cotton; turf and pasture grasses; ornamental plants; shrubs; trees; vegetables, berries, fruits, and other commercially-important crops including garden and houseplants.

In a related aspect, the present invention also encompasses a seed produced by the transformed plant, a progeny from such seed, and a seed produced by the progeny of the original transgenic plant, produced in accordance with the above process. Such progeny and seeds will have one or more crystal protein transgene(s) stably incorporated into its genome, and such progeny plants will inherit the traits afforded by the introduction of a stable transgene in Mendelian fashion. All such transgenic plants having incorporated into their genome transgenic DNA segments encoding one or more Cry1C-R148A, Cry1C-R148D, Cry1C-R148G, Cry1C-R148M, Cry1C-R148L, Cry1C-R180A, Cry1C.499, Cry1C.563 or Cry1C.579 crystal proteins or polypeptides are aspects of this invention. Particularly preferred transgenes for the practice of the invention include nucleic acid segments comprising one or more *cry1C-R148A, cry1C-R148D, cry1C-R148G, cry1C-R148M, cry1C-R148L, cry1C-R180A, cry1C.499, cry1C.563* or *cry1C.579* gene(s).